Sudbury Neutrino Observatory – Detector Commissioning and Year 1 Operations

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The Sudbury Neutrino Observatory [1,2] (SNO) is a next-generation water-Cerenkov solar neutrino detector operating 2020 *m* underground near Sudbury, Ontario, Canada in an active nickel mine owned and operated by INCO Ltd. The SNO collaboration consists of ~75 physicists from eleven institutions in Canada, Great Britain, and the United States. SNO has been operating in a stable neutrino detection mode since October 1999, with the completion the significant construction and commissioning activities.

Detector "live-time" is currently ~85% with the "dead-time" dominated by calibrations data taking. Of the inner detector's 9456 PMTs installed on LBNL's PMT Support Structure and their associated electronics channels, 98.5% are fully functioning. Only ~175 PMTs are no longer functioning. The stability and low trigger rate of the detector have permitted a global reduction in channel thresholds with the current threshold of ~0.25 pe/PMT. The average noise rate at these thresholds is ~500 *Hz* and contribute an average of ~0.5 noise hits in the 100 *ns* in-time event window. The PMT noise rate continues to decrease. The current hardware threshold results in a trigger rate of ~15 *Hz*.

Electronics calibration data is routinely taken and analyzed, including slopes and pedestals for charge and time. Optical and energy calibration data has been taken and are being analyzed. From these preliminary analyses we anticipate an energy response slightly higher than our initial Monte Carlo simulations predicted, around ~9 PMTs/MeV. The PMT timing resolution is near our expected goal of 1.7 *ns*.

Heavy Water recirculation and purification is ongoing. Assays for uranium and thorium decay chains are performed periodically. These confirm the current H_2O and D_2O contamination levels are near or below our design goals and continue to improve. Light water is continuously recirculated, cooled, and purified.

The muon-rate in SNO is measured to be ~3/hour. Flashing PMT rates vary by factors of 2 with an average of ~1/minute in the full array. These events are easily tagged and eliminated and can, in part, be correlated to seismic events.

We anticipate one year of data taking in the pure D_2O mode of the experiment. Counting statistics and background levels primarily determine the duration for this Charged Current phase (measurement of the ν_e rate and spectrum and the elastic scattering rate and spectrum). Following this phase, the first of two Neutral Current methods will be deployed. These involve either the addition of $MgCl_2$ salt to the D_2O to enhance the capture of neutrons created by Neutral Current neutrino interactions or the installation of an array of ^3He proportional counters to permit the simultaneous measurement of CC and NC signals. Both methods will ultimately be used by SNO to cross calibrate this critical measurement. Each of these methods will require one year of operation.

The LBNL group actively participates in the operation of SNO and currently focuses on data analysis. LBNL founded, organizes and leads the efforts of the West Coast Analysis Alliance formed of LBNL, University of Washington, LANL, and University of British Columbia.

Footnotes and References

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1. The SNO Collaboration, "Sudbury Neutrino Observatory Proposal", SNO 87-12 (1987).

2. The SNO Collaboration, "The Sudbury Neutrino Observatory", *accepted for publication by NIM A.*